Integrating Hydrogen into Existing Clean Fuel Corridors

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Summary

- Existing Clean Fuel Corridors present opportunities for H_2 development
- Challenges for H_2 development presented in clean fuel corridors
- Criteria for identifying potential projects to integrate H_2 into existing NGV deployments
- Propose Scope of work to coordinate H_2/NG efforts

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Background on ICTC

- **Interstate Clean Transportation Corridor founded in 1996**
- **Steering Committee: U.S. DOE; U.S. EPA; CEC; ARB; SCAQMD; MDAQMD; AVAPCD; SANBAG; RCTC**
- **The most-successful planned clean fuel corridor development project in the nation**
- **Mission: Develop a public-private partnership to accelerate the commercialization of alternative fuels in goods movement by concentrating public resources on the deployment of new, clean-fuel heavy-duty tractors, the development of a network of refueling facilities to serve these vehicles, and the linkage of these facilities to existing fleets of AFVs to ensure the economic sustainability of the system.**

Elements of Successful Clean Fuel Corridors

- **Clean Fuel Corridors (CFCs) are for HDVs**
  - ✓ **LD AFVs limited range, fleet oriented deployment restrict to intra-city travel**
  - ✓ **HDVs designed to travel between cities, states**
  - ✓ **HDVs consume prodigious volumes of fuel**
- **LNG dominant (but not only) fuel ICTC**
  - ✓ **Provide range needed in AFV HDVs**
  - ✓ **Minimize weight penalty**
  - ✓ **Infrastructure more flexible**

Elements of Successful Clean Fuel Corridors (cont.)

- **Corridor developed incrementally through simultaneous infrastructure development with AFV fleet deployment**
  - ✓ **Strategically located existing fleets**
  - ✓ **Enough vehicles to economically support station**
  - ✓ **Need sufficient fuel throughput to justify fueling infrastructure**
- **Public-Private Partnerships**
- **Concentrate Public, Private resources on High probability projects**

Benefits of Blending H_2 with Natural Gas

- **SunLine Transit experience:**
  - **50% reduction in NOx emissions**
  - **7% reduction in CO_2**
  - **Slight improvements in power, torque**
- **When H_2 replaces CH_4, range is reduced (80/20 mix by vol. = 15% ↓); In proposed LNG configuration, however, H_2 component will increase range**
- **Increased load for stations; valuable experience; opportunity for suppliers, vendors to reduce costs**

Challenges to H_2 in Clean Fuel Corridors

- **CNG Buses and Trucks**
  - **Reduction in range**
- **LNG Trucks**
  - **Requires integration of another fuel into the system**
  - **Need for on-board blending**
- **Complexity (2 and 3 fuels?!)**
- **Adding H_2 Storage increases Weight (cylinders)**
- **Costs**
  - **Hydrogen**
  - **Vehicle conversion,**
  - **On-site hydrogen production**

Opportunities for H_2 in Clean Fuel Corridors

- **Centralized fleets**
  - **Centralized fueling**
  - **Return-to-base**
  - **Central management and control**
- **Prodigious fuel consumption**
- **Public Accessibility - Stations serve a larger vehicle population (opportunity for growth)**
- **Existing natural gas infrastructure**
- **Operator familiar w/alternative fuels**
- **LNG reduces gas quality issues (H_2 production)**

Proposed ICTC Sites for H_2 Integration

- **USA Waste, City of Fresno**
  - LNG refuse collection trucks
  - Mack E7G engines
- **City of Barstow**
  - CNG transit buses
  - Goshen 25 ft buses w/Cummins 5.9L B Gas Plus
- **City of Tulare**
  - CNG integration
- **Harris Ranch, City of Coalinga**
  - LNG over-the-road trucks
  - Dual-fuel engines

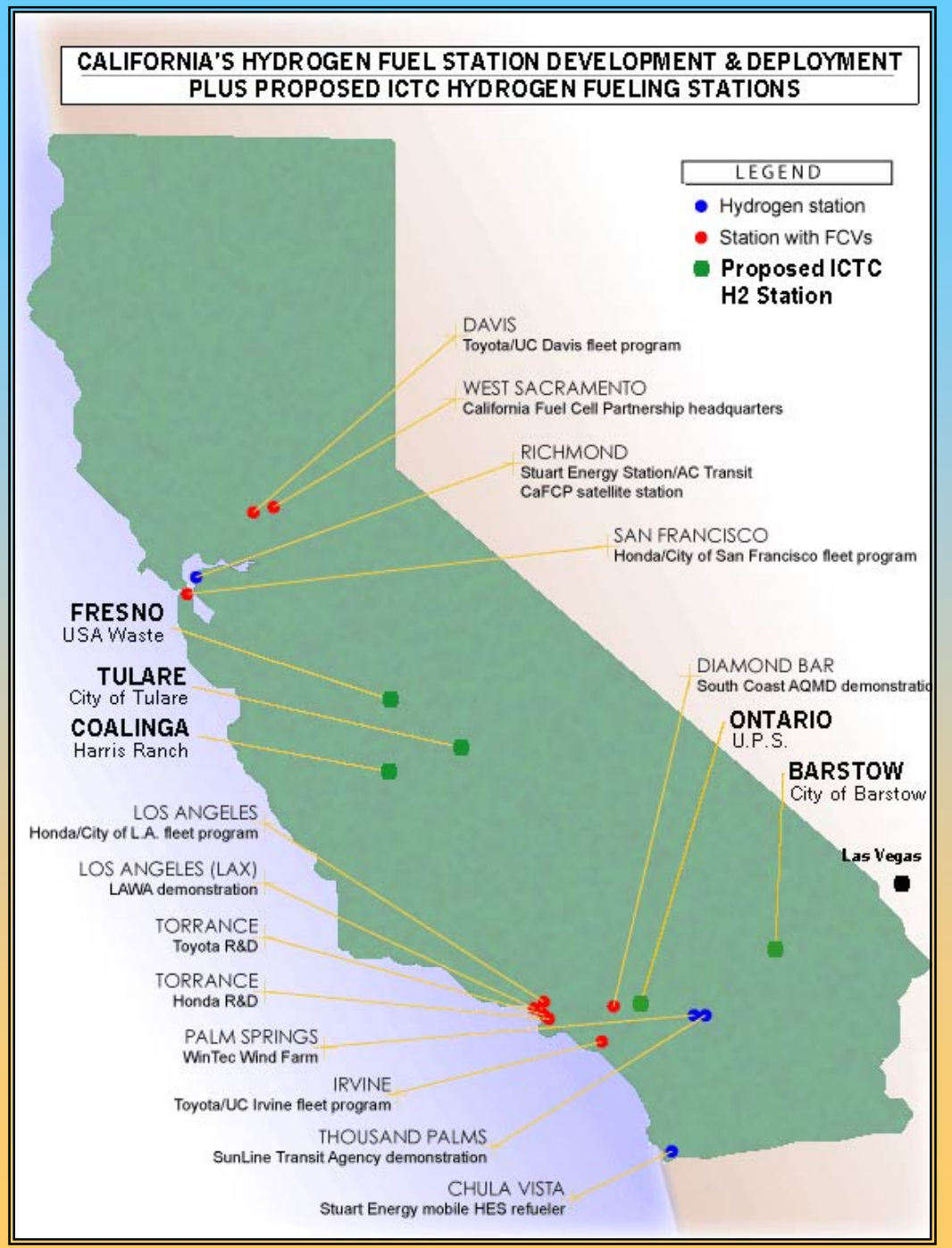
Advantages of Approach

- Link to existing AF corridor – CNG, LNG as bridge to Hydrogen Future
- Bridge gaps in emerging H_2 infrastructure
- Create Clean Fuel Clusters – LNG and Hythane for HDVs, LCNG & H_2 for LDVs
- Work with fleets with AFV experience
- Utilize existing NG vehicles as consumers of H_2
- Collaborate with existing H_2 development efforts

Link to Existing Corridor

- No need to “reinvent the wheel”; successful mechanism already in place
- Natural gas infrastructure exists in strategic locations through LNG
- Fleets (both public & private) with AFV & AF infrastructure experience
- Capable public-private partnership with experienced management
- Established, effective and well coordinated working relationships btw public agencies, private sector

Current and Proposed H_2 Stations and Proposed ICTC H_2 Stations



Work with Fleets with AFV Experience

- Know the difficulties of trying new technology; know what to expect
- Understand bureaucracy, application processes, reimbursement, reporting, etc., that comes with participation in AFV projects using grant funding
- More likely to appreciate the non-monetary benefits
- Have existing relationships

Discussion

OF THE ICTC

- Identify and Secure Participation of Early Adopters
- Concentric Circles – Build the Corridor by focusing on the development of H_2 nodes/clusters/villages
- Coordinate goals of many public agencies and private interests
- Leveraging funding from multiple sources to "stretch" funding for the project
- Integrate H_2 into ICTC by promoting a technology mix (because of status of the technology
- Primary difference: Much more focused on technology demonstration than ICTC

Next Steps

- Identify and Define Needed New Technology
- Identification, Allocation of Resources
- Secure Commitments from Participants
- Secure and Provide Specifications for Sites
- Ascertain 3rd Party Use for Proposed Sites